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TASK OUTLINE FOR HG-1 HAND-GENERATOR

SECURITY CLASSIFICATION : SECRET

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I. AIM.-

The aim of this task is the production of working prototype models, design information, and complete manufacturing drawings and specifications for a lightweight, miniaturized, hand-driven D. C. generator to be employed as a primary power source for both the high voltage, low current, requirements of the anodes; and the low voltage, high current, requirements of the filaments and/or heaters; of radio transmitting and receiving equipment.

II. NOMENCLATURE.-

The assigned nomenclature of this equipment shall be HG-1. Preliminary engineering models will be assigned the nomenclature HG-1X-1, -2, -3, etc., as may be necessary.

III. GENERAL.-

The GN-58 Hand-Generator, as used by the U. S. Army Signal Corps, more than adequately meets the requirements of the Government electrically, and is satisfactory mechanically. However, its weight and size are prohibitive. Preliminary studies indicate that it is well within the capabilities of modern design and manufacturing facilities to produce a hand-generator meeting the requirements of the Government in approximately one-half the size and one-half the weight of the GN-58. The hand-generator developed under this Task must closely approach these criteria if it is to be useful to the Government. Complete requirements will be outlined under CHARACTERISTICS AND REQUIREMENTS.

IV. WORK PROGRAM.-

The work under this Task shall be in two phases:

1. A study phase
2. A design phase

The purpose of the study phase is to determine the feasibility of building a model within the outlined limits. A comprehensive engineering report of the study phase is a basic requirement of this Task. The report should, in the case of a negative answer, show adequate proof of the nonfeasibility, with adequate documentation and reference to recognized authorities and/or results

of experimental tests. In the case of a positive answer, the report should show, in addition to proof of feasibility, the following:

1. Estimates of unit cost of the manufactured item
2. An artist's sketch showing form factor and configuration
3. Size and weight estimates
4. Estimate of physical man-power input required
5. Electrical diagrams and circuit description

As a guide for the study phase, it is suggested that the following be investigated:

1. Basic materials of construction, including grain-oriented steels for the electromagnetic circuits, ceramics and silicones for wire coatings and other insulation, the light metals for structures and enclosures, nylon and other plastics for gearing and/or toothed rubber belt drives for the speed changing mechanism, and other recent developments in high-efficiency materials of construction.

2. A mechanical-electrical efficiency study of the best methods of accomplishing speed multiplication.

3. An intensive size and weight reduction study, resulting in finite estimated figures in cubic inches and pounds for the final unit.

4. An analysis of the generator electrical system, including voltage regulation of the basic electrical machine at constant rated speed, voltage regulation of the complete generator with included regulating device at specified variations in cranking speed, specified per cent commutator ripple, specified conducted and radiated electrical noise, voltage regulation from estimated internal temperature rise, short circuit stability, and other beneficial electrical studies.

5. The practicability of going to the newly developed high temperature techniques for electromagnetic devices, wherein the windings are operated just a little below a red heat.

6. The practicability of other lighter designs than the familiar tripod legs and seat used with the GN-58. These legs and seats weigh approximately five pounds. Permanently attached telescoping short legs and folding seat is one suggestion. A folding foot or knee pad to allow operating the unit in a kneeling position should also be investigated.

7. The practicability of going to a lighter weight, semi-permanently attached, folding, hand-cranking mechanism.

At the completion of the study phase, or at any time prior at the contractor's request, a consultation will be held with Government engineers to re-examine the Task in the light of the findings of the study phase.

After the mutually satisfactory resolution of any technical or design difficulties, the Task will proceed into the design phase. The design phase is to be subdivided into the following periods:

Period 1. Preliminary Design.- This shall be a paper design of the unit, based upon the results of the study phase and aimed at producing a set of drawings and specifications for the construction of an engineering model. Preliminary tests of components or subassemblies of the final unit shall be conducted to verify their suitability for the application. At the conclusion of this period, the design and data shall be checked and evaluated by representatives of the Government.

Period 2. Engineering Model Construction and Tests.- During this period an engineering model shall be constructed, and complete tests shall be performed in accordance with the specification. The test shall be witnessed and/or reviewed by representatives of the Government. The satisfactory completion of the specification tests shall precede the submission of the model to the Government for preliminary operational tests at Government-operated laboratories.

Period 3. Production Prototype Design.- Upon completion of Government operational tests, estimated to require approximately thirty days, the Government may require changes or modifications in the equipment prior to production. The desired changes or modifications shall be transmitted in writing to the contractor who shall incorporate such changes into the design of the production prototypes. It must be kept in mind that the design during this period is for quantity production using modern production line techniques. Any difficult design requiring excessive costs in fabrication and/or excessive tooling and set-up time shall be subject to review by representatives of the Government. A decision shall be rendered as to whether or not the ends justify the means. This period shall encompass all design changes necessary to produce a complete set of manufacturing drawings suitable for direct reproduction, a bill of material of all nonfabricated parts and components including data as to capacity, tolerance, formula, composition, or definition, as may be required for purchasing. The manufacturer or supplier of said parts shall be identified, and the cost in some unit quantity shall be stated.

Complete manufacturing instructions where applicable shall be included, as well as complete test procedures for prototype tests and production tests. The submission of a report giving the above information, the drawings, the complete revised specification, and five production prototypes meeting the specification, shall terminate the Task. Acceptance tests of the five prototypes shall be conducted by Government engineers at a Government test facility.

V. CHARACTERISTICS AND REQUIREMENTS.-

1. Physical:

Size - 250 cubic inches (complete generator unit in outside case only)

Weight - 10 pounds (less cranks and stand, or tripod)

2. Electrical:

Output Rating: 425 ± 25 volts at 0.100 A
105 volts at 22 ± 2.5 ma.
6.3 ± 0.1 volts at 2.4 A.
1.4 volts at 0.300 ± 0.020 A.

Voltage Regulation:

The generator shall have rated test loads of 0.425 ampere on the high voltage winding and 2.75 amperes on the low voltage winding when tested for voltage regulation/load, voltage regulation/speed, low voltage change with change of temperature, and ripple voltage.

With the generator operating at a cranking speed of 60 rpm under rated test loads, the high voltage shall not vary more than 8 per cent from its full load value when the high voltage load is removed.

With the generator operating at a cranking speed of 60 rpm and the high-voltage output unloaded, the low voltage shall not vary more than 10 per cent from its full-load test value when the low-voltage load is removed.

With the generator operating at any cranking speed between 50 and 70 rpm inclusive and under rated test loads, the output voltage shall not deviate more than plus or minus 2 per cent from the values obtained at 60 rpm.

With the generator operating at any cranking speed between 50 and 70 rpm inclusive, under rated test loads, and at any ambient temperature between minus 40 to plus 165 degrees F., the low voltage shall not deviate more than 2 per cent from the value measured under the same load and cranking speed at room temperature.

With the generator operating at a cranking speed of 60 rpm, under rated test loads at any temperature between minus 40 and plus 165 degrees F., the rms ripple voltage shall not exceed 1 per cent of either the high or low output voltage when tested for voltage regulation/load.

Electrical Noise:

The generator shall have adequate filtering and shielding against conducted and radiated electrical noise. The residual noise remaining shall be no greater than, and preferably less than, that from the GN-58 Hand-Generator.

3. Mechanical:

Life: 300 hours without repair, adjustment, or lubrication. This shall not be construed as life expectancy but rather is a minimum functional requirement.

Preservation: Shall be water immersion proof, tropicalized, including fungus resistant.

Strength: Shall be sufficiently rugged to withstand vibration, and the bouncing and shock of rough handling.

Acoustic Noise: The acoustic noise produced by the generator when cranked at rated speed under a high-voltage load of 0.050 ampere and a low-voltage load of 2.4 amperes shall be less than a sound level of 57 db at 70 db weighting and 54 db at 40 db weighting when measured in a room having an ambient noise level of not more than 40 db with a sound level meter (Type 759-B as manufactured by General Radio Company, Cambridge, Massachusetts, or equal) whose microphone is at a distance of 3 feet from the top front edge of the generator.